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REC'D 23 AUG 2000
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The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

22 JUN 1999

1. Your reference P24038/HGR/GMU

2. Patent application number *(The Patent Office will fill in this part)* **9914414.9**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Rocep Lusol Holdings Limited
Rocep Business Park
Kings Inch Road
Deanpark
RENFREW
PA4 8XY

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

"A Valve for use with Apparatus for Introducing a Predetermined Dose of Additive into a Liquid"

5. Name of your agent *(if you have one)*

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

373 Scotland Street
GLASGOW
G5 8QA

Patents ADP number *(if you know it)* 1198013

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
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Claim(s)	0
Abstract	0
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	–
Request for preliminary examination and search *(Patents Form 9/77)*	–
Request for substantive examination *(Patents Form 10/77)*	–
Any other documents *(please specify)*	–

11. I/We request the grant of a patent on the basis of this application.

Signature Murgitroyd & Co. Date 21 June 1999

Murgitroyd & Company

12. Name and daytime telephone number of person to contact in the United Kingdom

Graham Murnane
0141 307 8400

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A valve for use with apparatus for introducing a predetermined dose of additive into a liquid

The invention relates to a single use valve which allows fluid to pass from the interior of a tube to the exterior, and in particular to a valve for use with a container which automatically adds an additive in the form of a liquid or a pourable solid to a liquid in the container on opening of the container.

In a wide number of applications, such as pharmaceuticals for both human and animal use, agrochemicals and other more general applications it may be necessary to release and mix a liquid catalyst or reagent into a liquid before the liquid may be used. In other applications, such as in the beverage industry, it may be desirable to add a component to a beverage immediately before consumption of the beverage, for example to effect a colour change, or to create a mixed beverage which has a limited storage life in the mixed state.

British Patent Application No 9823578 discloses an apparatus for introducing a component into a first liquid, the apparatus comprising a first container ,

such as a bottle, which holds the first liquid. The container has an opening closed by a releasable closure. A second container or tank containing pressurised propellant fluid is positioned in the neck of the first container, adjacent to the opening. A dip tube or conduit is attached to the tank, and has a first end communicating with the tank and a second end extending down into the first liquid in the first container. The dip tube contains an additive which is expelled from the dip tube into the first liquid by the entry of the propellant fluid from the tank into the conduit on release of the releasable closure.

The preferred form of dip tube is a polypropylene tube of circular cross-section, typically having an internal diameter of 5.8 mm. Such a tube has an internal capacity of 0.26 ml for each 10 mm length, so an 80 mm long tube can hold approximately 2 ml of product. The tank typically has a capacity of 2 ml, and contains pressurised propellant gas.

When the tank is of an impermeable material such as metal, then the headspace required for the propellent gas is only a proportion of the total tank volume, leaving the remainder of the tank volume available for product.

However when the tank is of a material such as plastic which exhibits long term permeability, then the headspace required for the propellent gas must be maximised, and none of the tank volume is available for product. In such cases it can be necessary to use larger diameter dip tubes capable of holding more product, and there is then a need for a valve arrangement at the lower end of the dip tube so that product does not drip into the first liquid in the

first container. The use of small diameter dip tubes such as capillary tubes avoids the need for valves, but such small diameter dip tubes can only hold a small amount of product.

There is therefore a need for a simple, inexpensive valve arrangement which prevents the product in a dip tube from leaking or dripping into the first liquid in the first container when the dip tube and first container are at the same pressure, but which allows the passage of liquid or pourable solid product from the dip tube into the first liquid in the first container when the dip tube is pressurised by introduction of the propellant fluid.

According to a first aspect of the present invention there is provided a valve comprising an expandable tubular member and a sleeve member surrounding at least a portion of said expandable tubular member, wherein the expandable tube member has a closed end and at least one aperture therein adapted to permit the expulsion of fluid under pressure from the expandable tube member, and is expandable between a first unexpanded state in which the aperture is closed by contact with either the sleeve or a part of the expandable tubular member and a second expanded state in which the aperture is open.

Preferably the expandable tubular member is of plastic, most preferably of polypropylene. Preferably the sleeve is of plastic, most preferably of polypropylene. Preferably the tubular member and sleeve are both of circular cross-section.

Preferably the expandable tubular member comprises a corrugated portion adapted to concertina between said

unexpanded and expanded states. Preferably said corrugated portion comprises a plurality of concertina-like ribs, each rib comprising a length of tube of increasing cross-sectional area and a length of tube of decreasing cross-sectional area. Preferably said sleeve comprises an inwardly directed flange at its upper end remote from the closed end of the expanded tubular member, adapted to engage with a corrugated portion of the expanded tubular member.

There may be provided more than one aperture, arranged circumferentially around the expandable tubular member.

According to a first preferred embodiment the aperture is provided in a concertina-like rib of said corrugated portion, most preferably in the lower rib adjacent to the closed end of the expandable tubular member. Preferably the lower rib is of larger external diameter than the upper ribs and is adapted to seal against the internal surface of the sleeve. Preferably the closed end of the expandable tubular member is formed by heat sealing.

According to a second preferred embodiment the aperture is provided in a uniform diameter portion of the expandable tubular member. Preferably the sleeve comprises an upper portion of larger diameter which fits around the corrugated portion of the expandable tubular member and a lower portion of smaller diameter which fits sealingly around the uniform diameter portion of the expandable tubular member. Preferably the closed end of the expandable tubular member is formed by an insert, preferably a concave insert, fixed inside the tubular member below the aperture.

According to a second aspect of the present invention

there is provided a valve comprising an expandable tubular member, wherein the expandable tube member has a closed end and at least one aperture therein adapted to permit the expulsion of fluid under pressure from the expandable tube member, and is expandable between a first unexpanded state in which the aperture is closed by contact with a part of the expandable tubular member and a second expanded state in which the aperture is open.

Preferably the expandable tubular member is of plastic, most preferably of polypropylene. Preferably the tubular member is of circular cross-section.

Preferably the expandable tubular member comprises a corrugated portion adapted to concertina between said unexpanded and expanded states. Preferably said corrugated portion comprises a plurality of concertina-like ribs, each rib comprising a length of tube of increasing cross-sectional area and a length of tube of decreasing cross-sectional area.

There may be provided more than one aperture, arranged circumferentially around the expandable tubular member.

Preferably the aperture is provided in a concertina-like rib of said corrugated portion, most preferably in the lower rib adjacent to the closed end of the expandable tubular member. Preferably the closed end of the expandable tubular member is formed by heat sealing.

According to a third aspect of the present invention there is provided an apparatus for introducing a component into a first liquid, the apparatus comprising:

a first container for holding the first liquid having an opening closed by a releasable closure,
a second container located in the first container and containing propellant fluid, and
a conduit having a first end communicating with the second container and a second end communicating with the first container;
wherein the conduit contains an additive which is expelled from the conduit into the first liquid by the entry of the propellant fluid into the conduit on release of the releasable closure;
and wherein the conduit is provided at its second end with a valve according to the first or second aspects of the present invention.

Preferably the conduit comprises a plastic tube, at the lower end of which is formed the expandable tubular member. A sleeve may be provided, wherein the sleeve comprises a plastic tube adapted to fit around the lower end of the plastic tube forming the conduit.

Preferably the conduit extends below the surface of the first liquid in the first container. Alternatively the conduit may extend to a position close to the wall of the first container above the surface of the first liquid, to avoid foaming of the liquid and the creation of pressure waves in the liquid. The first container may be a bottle having a neck, and the conduit may extend to a position adjacent to the wall of the neck.

The conduit may contain a number of additives arranged at different positions along the length of the conduit. The additives are preferably liquid. The additives may be colouring agents, flavouring agents, fragrances, pharmaceutical components, chemicals, nutrients, liquids containing gases in solution etc.

Examples of apparatus in accordance with the invention will now be described with reference to the accompanying drawings, in which:-

Figs. 1(a) to 1(e) are cross-sectional views of a first embodiment of an apparatus of the invention, in which the second container is integrally formed in a bottle top, showing the top before screwing on, during screwing on, screwed on tight, during release and fully removed respectively;
Fig. 2 is a cross-sectional view of the embodiment of Fig. 1(a) to an enlarged scale;
Fig. 3 is a cross-sectional view of the embodiment of Fig. 1(a) showing the valve of the invention in its expanded or open state;
Fig. 4 is a cross-sectional view of the embodiment of Fig. 1(a) showing the valve of the invention in its contracted or closed state;
Fig. 5 is a cross-sectional view through the valve of Fig. 4 in its contracted or closed state;
Fig. 6 is a cross-sectional view through the valve of Fig. 5 in its expanded or open state;
Fig. 7 is a cross-sectional view through a valve according to a second embodiment of the invention in its contracted or closed state; and
Fig. 8 is a cross-sectional view through the valve of Fig. 7 in its expanded or open state.

Figs. 1(a) to 1(e) show an apparatus for automatically dispensing a product from a dip tube to a bottle or first container by means of pressurised propellant stored in a tank or second container when the top is removed from the bottle. The tank or second container is integrally formed with a screw top which is then screwed onto the bottle or first container, in the neck of which is secured an insert which has a rupturing

spike and a dip tube.

Fig. 1(a) shows a bottle 150 having an insert 100 secured within the neck 160 of the bottle, shown in more detail in Fig. 2. The screw cap 152 is shown separately, before closure of the bottle 150. The cap 152 has an internal thread to mate with the external thread on the neck 160 of the bottle. The cap has an integrally moulded cylindrical portion which forms an inner container 111, which is closed at the upper end by a convex portion 112 of the cap 152, so as to resist internal pressure in the inner container, and is open at the lower end 113. A circumferential groove 114 is provided externally at the lower end 113 of the inner container 111.

A plastic ferrule 170 comprises an inner cylindrical wall 172 forming a chamber which is open at its lower end and closed by a foil seal or membrane 180 at its upper end. The inner cylindrical wall 172 is connected and sealed at its upper end to an outer cylindrical wall 174, whose outside diameter is selected to fit tightly within the inside diameter of the inner container 111. At the lower end of the outer cylindrical wall 174 is provided a return flange 176 which has a circumferential rib 178 adapted to cooperate with the groove 114 on the outside wall of the inner container 11. The inner wall 172 has upper and lower sealing ribs 182, 183 which are adapted to provide a pressure resistant seal against the outer surface of the rupturing member 104.

The ferrule 170 is secured by a snap fit to the lower end 113 of the inner container 111, to provide a pressure resistant closure to the container. The inner container is filled with liquid 115 and pressurised gas

116 in a conventional fashion, so that the inner container is under internal pressure, causing the foil seal 180 to bow outwards.

An insert 100 is secured by any suitable means within the neck 160 of the bottle 150. The insert 100 comprises a substantially cylindrical housing 101 open at the upper end and having a number of legs 190 projecting from the lower end. The housing is provided with detent members 191 which engage with the inside of the neck 160 of the bottle, so that the insert 100 cannot be readily removed. The upper end of the housing has a lip 102 which is adapted to engage with a recess 103 in the neck 160 of the bottle, to prevent the insert from being pushed down inside the neck.

The legs 190 are connected at their lower end to a hollow spike member 104, which has a small diameter bore portion 105 at its upper end and a large diameter bore portion 106 at its lower end. Between the legs are apertures which allow the passage of liquid between the spike member 104 and the side of the bottle when the liquid is poured from the bottle. The number of legs and intervening apertures may be two, three, four or more as appropriate.

Within the wall of the small diameter bore portion 105 are provided a number of radial passages 108 which communicate with the hollow interior of the spike 104 and the interior of the housing 101. Extending from the bottom of the hollow rupturing member 104 is a dip tube or conduit 130, surrounded by a plastic or sprung steel cone washer 109 which is secured to the rupturing member 104 and serves as a one-way retaining member to allow the conduit 130 to be inserted up into the large diameter bore 106 but to restrain it from being removed

in a downwards direction. The large diameter bore portion 106 has an internal diameter equal to the external diameter of the dip tube 130. The step between the large and small diameter bore portions 105, 106 prevents the dip tube 30 extending into the small diameter bore portion 105 and blocking the radial apertures 108.

In use, the inner container 111 is filled with a liquid 115 and a pressurised gas 116 by means of conventional technology used to fill pressurised dispenser packs, commonly known as aerosol containers. Alternatively the inner container 111 may be filled solely with pressurised gas 116, omitting the liquid 115.

Fig. 1(b) shows the cap 152 while it is being screwed on to the neck 160. On application of the closure or cap 152 to the bottle 150, the inner container 111 is moved downwards and the spike 104 enters the space formed by the inner cylindrical wall 172 of the ferrule 170.

When the closure 152 is fully screwed tight on to the bottle 150, the inner container 111 moves to the position shown in Fig. 1(c), in which the seal member 154 inside the cap 152 seals tightly against the top 156 of the bottle neck 160. When this happens, the spike 104 bursts the rupturable membrane 180 and the member hollow spike extends into the inner container 111. In this position the liquid 115 and gas 116 are prevented from escaping from the inner container 111 by the ferrule 170 and spike member 104 which seal against each other to prevent release of the liquid 115 and gas 116 from the container 111. The upper sealing rib 182 and lower sealing rib 183 formed inside the inner cylindrical wall 172 of the ferrule 170 both seal

against the outer surface of the spike member 104.

The inner container 111 remains in the position shown in Fig. 1(c) until a user releases the closure 152 from the bottle 150. When this occurs, the inner container 111 moves to the position shown in Fig. 1(d). In this position the upper sealing rib 182 becomes unsealed from the spike member 104, but the lower sealing rib 183 remains in sealing contact with the outer surface of the spike member, below the apertures 108. This leaves an escape passage for the compressed liquid 115 (or gas 116), which is forced out of the container 111 by the pressurised gas 116 in the direction of arrows 184, 185, 186, between the spike member 104 and ferrule 170, through the radial passages 108 and into the dip tube 130. The liquid 115 or gas 116 then passes through the dip tube 130, expelling the concentrate or additive material 131 from the dip tube 130 through the valve 200, shown schematically in Figs 1 and 2, into the liquid or other substance contained in the bottle 150. On removal of the closure 152, the inner container 111 and ruptured ferrule 170 are removed from the bottle 150 together, as shown in Fig. 1(e), leaving the insert 100 and dip tube 130 in the bottle. The insert does not impede pouring of the liquid in the bottle, which can flow between the support legs 190 of the insert 100.

The dip tubes 130, typically thin-walled polypropylene tubes such as used in the manufacture of drinking straws or similar, may be of different diameter or length and may contain different predetermined doses of additives.

Figs 3 to 6 show a first embodiment of the valve 200 provided at the lower end of the dip tube 130. The

lower end of the dip tube 130 is provided with a series of ribs or corrugations 10, which allow the overall length of the dip tube to expand and contact by a concertina type action. The bottom of the dip tube is sealed 135, for example by heating and twisting the dip tube, or by any other suitable means.

A sleeve 12, whose internal diameter is slightly greater than the external diameter of the ribs 10, has an inwardly projecting return flange 14 at its upper end. This flange 14 engages with the first rib 10a of the series of ribs 10. The lowest rib 10z has a larger external diameter than the other ribs, so that in the folded or contracted state, as shown in Figs 4 and 5, the rib 10z is in resilient contact with the lower end of the sleeve 10. A number of apertures 18 are provided in the upper portion 20 of the lower rib 10z, although it is to be understood that the invention may function equally well if the apertures 18 are instead provided in another rib 10, near the lower end of the corrugated portion. The apertures should be near the lower end of the dip tube 130, in order to minimise wastage, since any liquid 131 in the dip tube below the apertures 18 will not be expelled through the apertures 18 when internal pressure is applied to the dip tube. Figs 5 and 6 show two apertures, on opposite sides of the dip tube 130, but in practice any number of apertures 18 may be provided. When the corrugated portion of the dip tube 130 is in the unexpanded state, the ribs 10 are in close contact with each other, so that the apertures 18 are effectively closed by contact with the adjacent rib 10.

When the cap 152 is removed from the bottle 150, compressed gas 116 is allowed to escape from the chamber 111, through the radial passages 108 and into

the dip tube 130, as explained above with reference to Figs 1(a) to 1(e). The pressurised gas forces the internal pressure in the dip tube 130 to be higher than that in the bottle 150, with the result that the corrugated portion of the dip tube expands.

As the lower rib 10z expands past the lower edge 22 of the sleeve 12, it is free to unfold, and the apertures 18 are no longer closed by close contact with the adjacent rib. The liquid 131 in the dip tube is then forced out of the apertures 18 under pressure in the direction of arrows 24. In this way no leakage of the liquid 131 in the dip tube 130 can occur from the dip tube to the surrounding liquid in the bottle 150 until the interior of the dip tube 130 is pressurised upon removal of the cap.

In a further embodiment, the sleeve 12 may be omitted, if the plastic of the dip tube 130 has sufficient plastic "memory", ie if the corrugations remain closely packed when the dip tube is unpressurised, so that the apertures remain blocked off by close contact with an adjacent rib until such time as the interior of the dip tube 130 is pressurised, and the corrugations expand.

Figs 7 and 8 illustrate a further embodiment of a valve 200 according to the invention. The lower end of the dip tube 130 is sealed by the addition of a concave insert 30, bonded to the interior wall of the dip tube 130. The concave form is selected so that deformation of the insert 30 is resisted when the interior of the dip tube is pressurised. Alternatively the bottom of the dip tube 130 may be sealed by heating and/or twisting 135, as shown in Figs 5 and 5.

Adjacent to the lower end of the dip tube 130 is

provided a tubular section 32 of uniform diameter, and above that a corrugated section 34 having a series of ribs or corrugations 40, which allow the overall length of the dip tube to expand and contact by a concertina type action.

A sleeve 42 has an upper portion 44, whose internal diameter is greater than the external diameter of the ribs 40, and a lower portion 46, whose internal diameter is just greater than the outside diameter of the tubular section 32 of the dip tube 130. The top of the sleeve 42 has an inwardly projecting return flange 48 at its upper end. This flange 48 engages with the first rib 40a of the series of ribs 40. A number of apertures 50 are provided in the tubular section 32, near the bottom of the dip tube 130. Figs 7 and 8 show two apertures, on opposite sides of the dip tube 130, but in practice any number of apertures 50 may be provided. The apertures 50 should be as low as possible, to minimise product wastage. When the corrugated portion 34 of the dip tube 130 is in the unexpanded state, as shown in Fig 7, the apertures 50 are effectively closed by contact with the adjacent sleeve portion 46.

When the cap 152 is removed from the bottle 150, compressed gas 116 is allowed to escape from the chamber 111, through the radial passages 108 and into the dip tube 130, as explained above with reference to Figs 1(a) to 1(e). The pressurised gas forces the internal pressure in the dip tube 130 to be higher than that in the bottle 150, with the result that the corrugated portion of the dip tube expands and adopts the position shown in Fig 8.

As the apertures 50 move as a result of the expansion

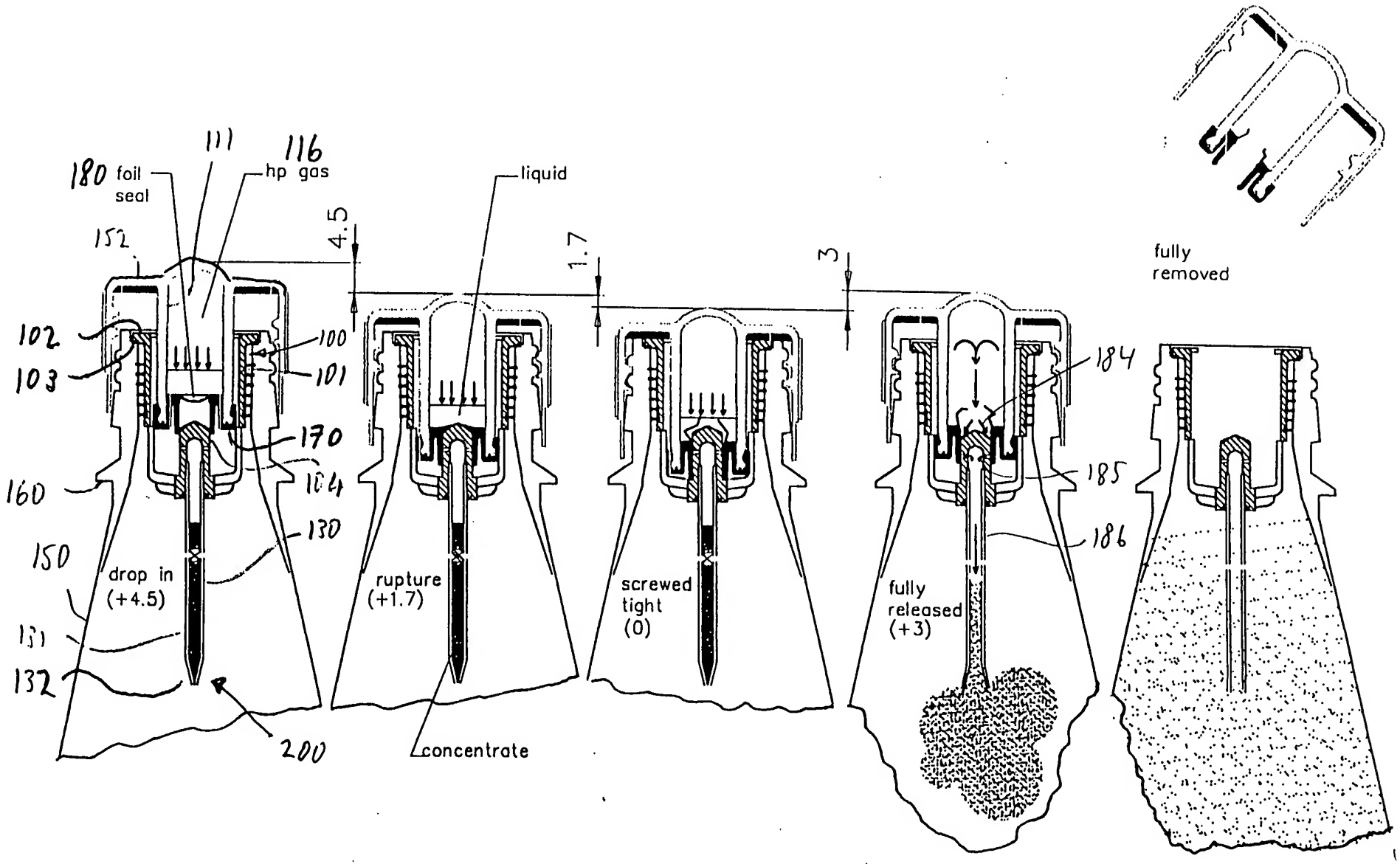
past the lower edge 52 of the sleeve 44, the apertures 50 are no longer closed by close contact with the sleeve. The liquid 131 in the dip tube is then forced out of the apertures 50 under pressure in the direction of arrows 54. In this way no leakage of the liquid 131 in the dip tube 130 can occur from the dip tube to the surrounding liquid in the bottle 150 until the interior of the dip tube 130 is pressurised upon removal of the cap.

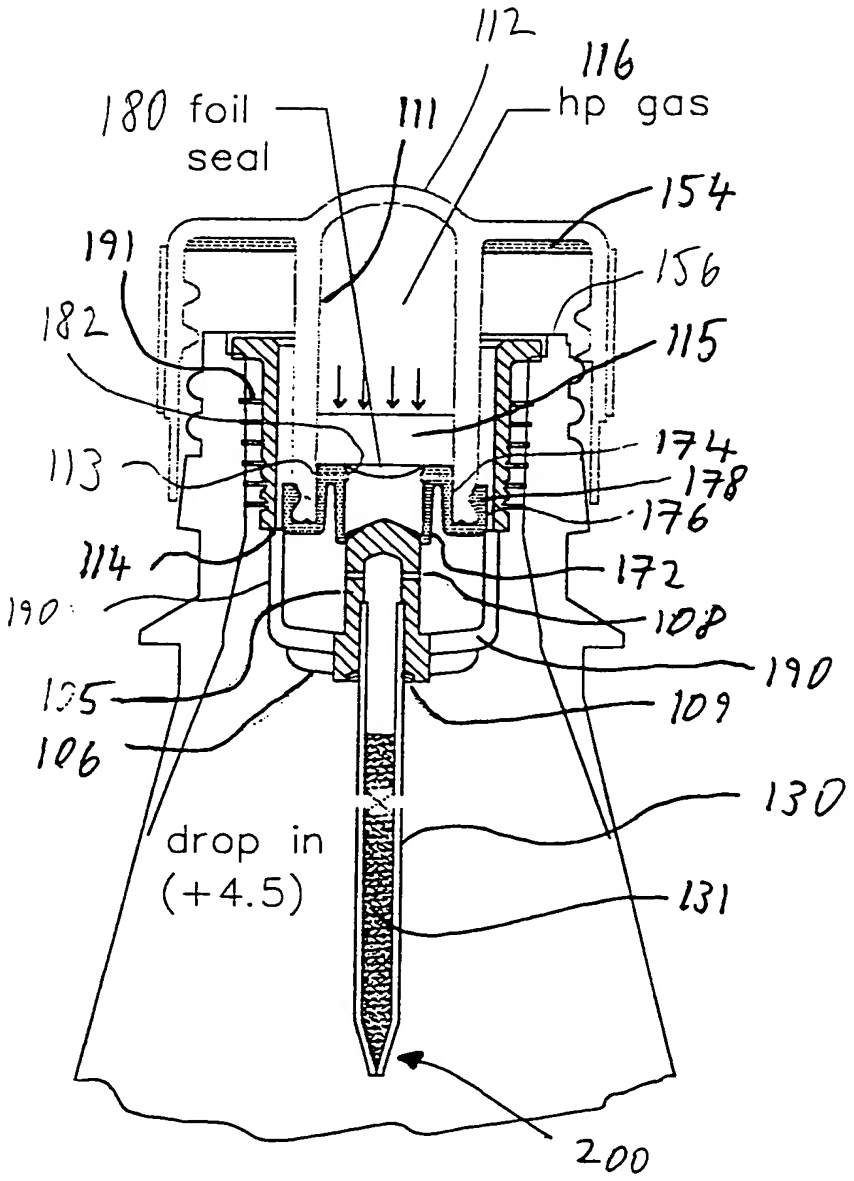
It is envisaged that the dip tube valve arrangement may find other applications, and the invention is not be limited to use of the valve with a pressurised dispensing device as shown in Figs 1(a) to 1(e).

The invention can be used with fragrances, flavouring, pharmaceuticals (particularly suitable because of the accurate dosage obtainable), chemicals, vitamins etc. The tubes can be filled precisely at a different location and then inserted into the housing at the point of filling the bottles. Compressed air or other gas is particularly suitable as a propellant for powdered or granulated solids, so that liquid does not cause the solids to adhere to the side of the dip tube.

Modifications and improvements may be incorporated without departing from the scope of the invention.

Fig. 1(a) Fig. 1(b) Fig. 1(c) Fig. 1(d) Fig. 1(e)

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116
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111
hp gas
154
191
156
182
115
174
113
178
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114
172
190
108
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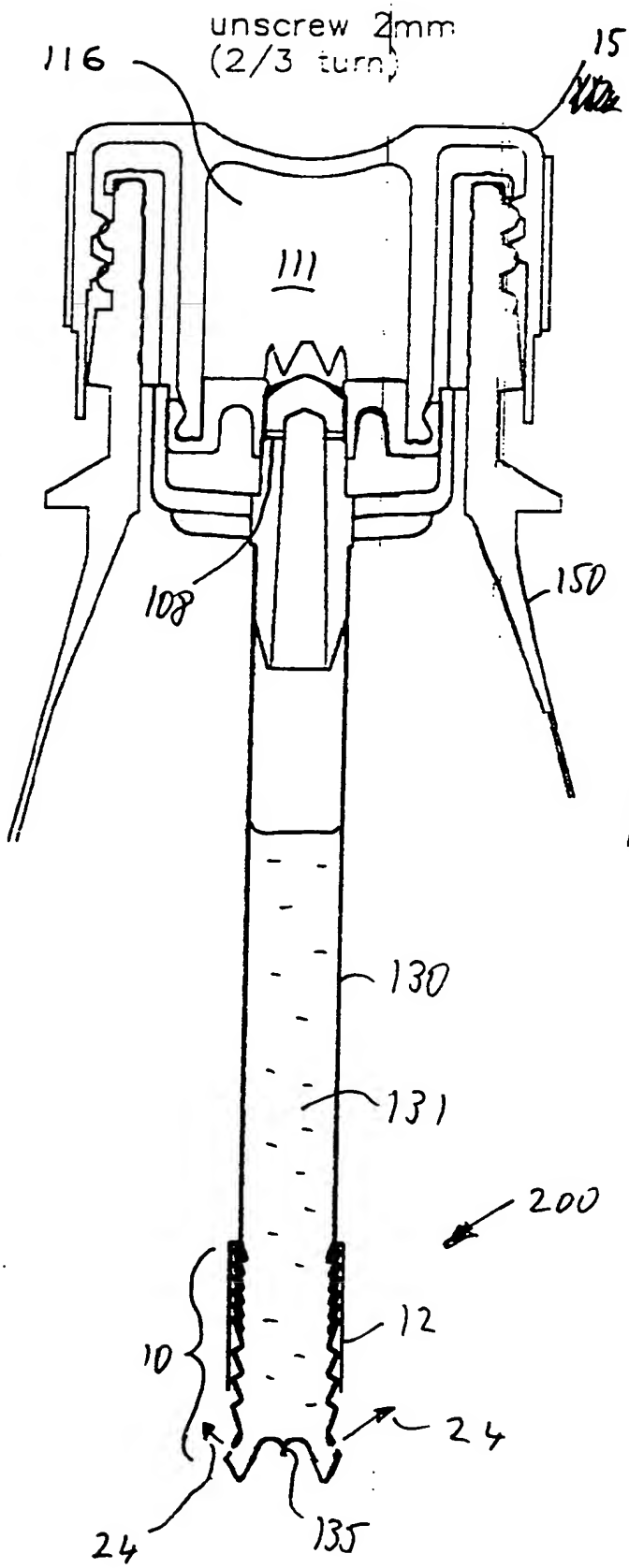
105
109
106
130
drop in (+4.5)
131
200

Fig. 2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(2/3 turn)
116
152
111
108
150
130
131
200
10
12
24
24
135

Fig. 3

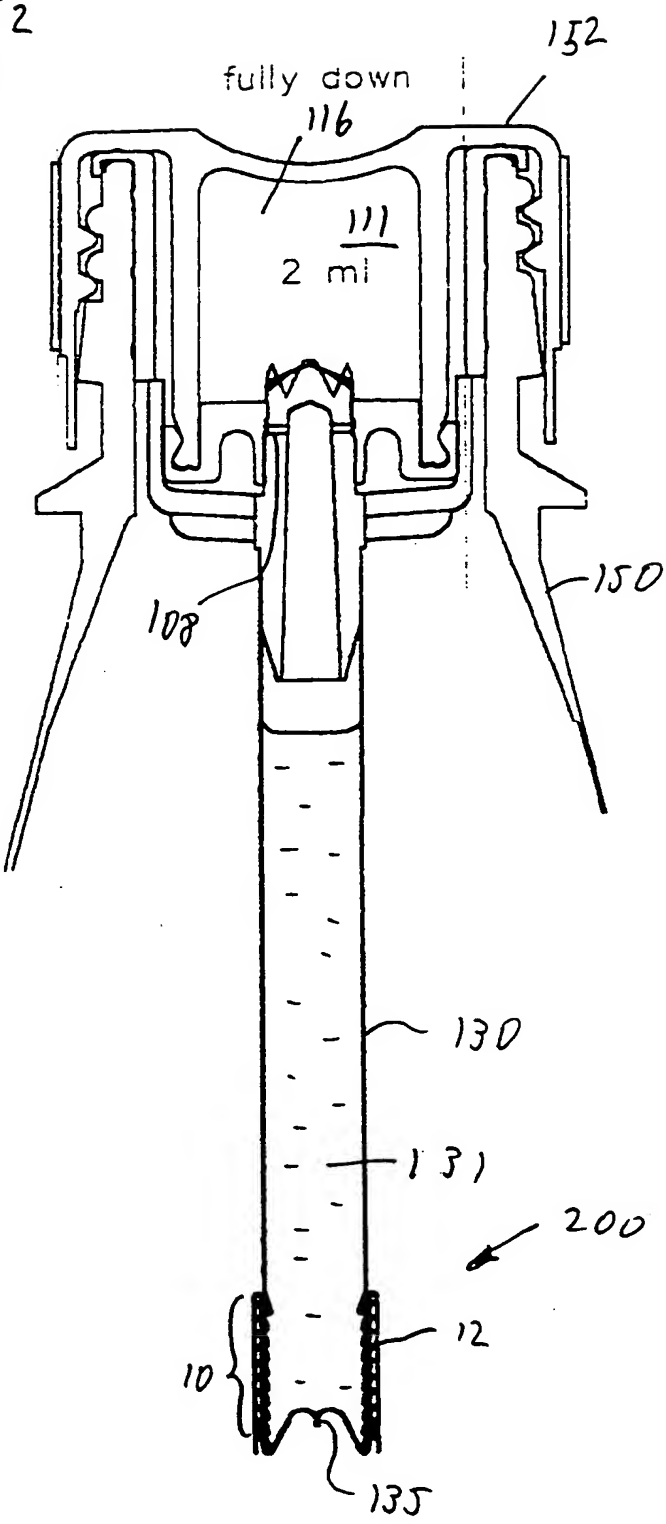
fully down
116
152
111
2 ml
108
150
130
131
200
10
12
135

Fig. 4

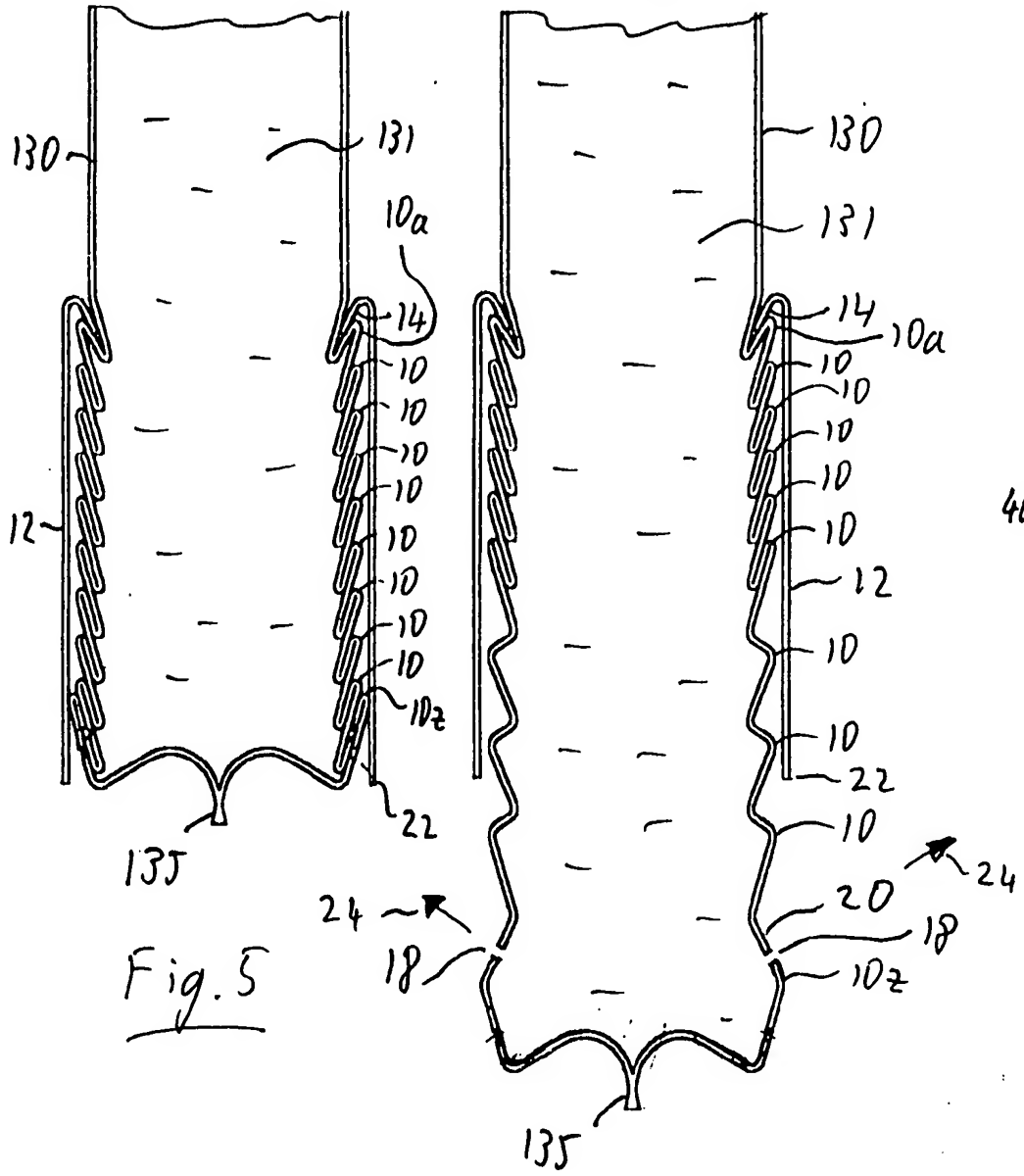

Fig. 5

Fig. 6

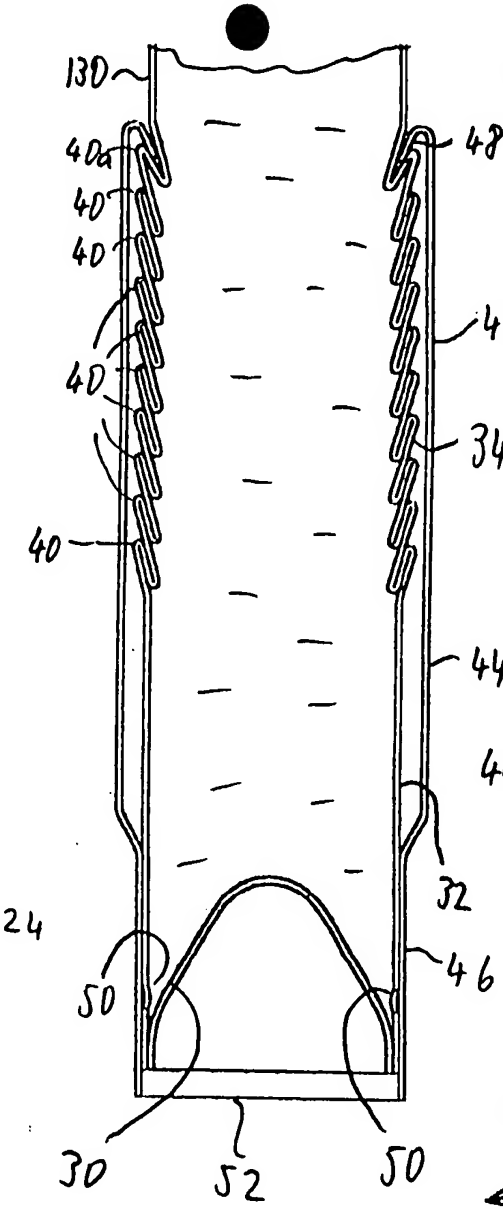

Fig. 7

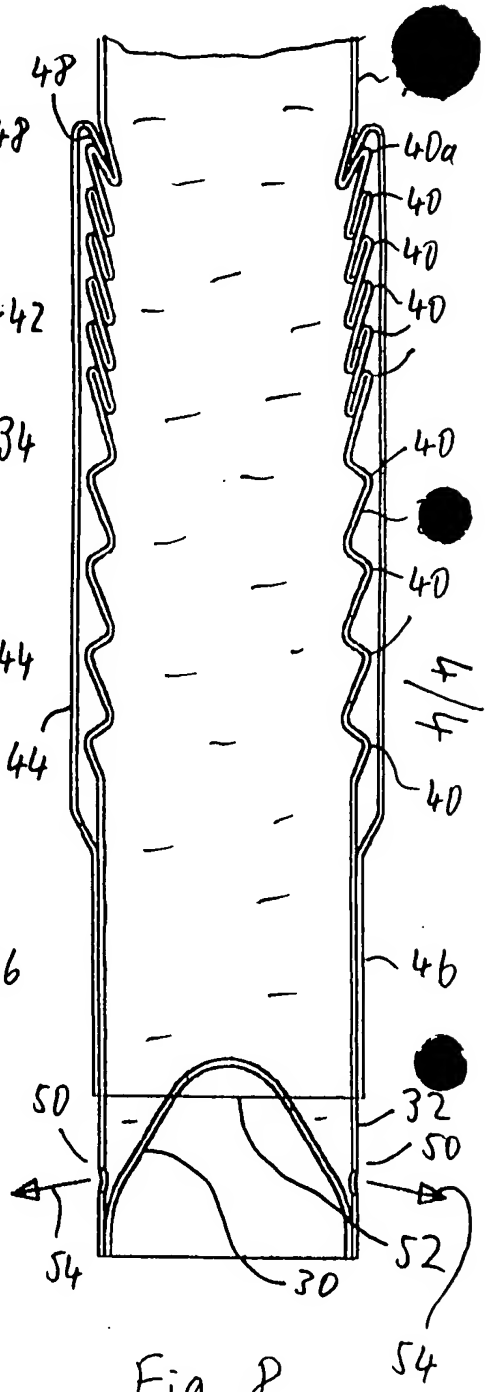

Fig. 8

PCT NO : GB00 / 02285

Form 23/77 : 7.7.00

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